

Comparative general statement of receipts, expenses, &c., since the government assumed charge of the canal.

Year.	Receipts.						Total boats and tonnage.		Number of days closed.	Number of lockages.	Cost per ton, including total expense of management.
	Source.						Number.	Tonnage.			
	Tolls.	Dry-docks.	Towing.	Dredge.	Rents.	Totals.					
1874*	\$19,000 25	\$464 28	\$45 00		\$20 00	\$70,395 53	1,164	274,265	93	1,401	9.12
1875	68,664 75	599 21	350 00		5 1 65	70,175 61	2,881	757,695 75	59	1,694	6.14
1876	79,854 31	220 96	275 00		412 00	80,762 27	3,264	871,446 50	60	1,664	5.60
1877	87,907 78	195 00	146 00	\$77 50	88,737 28	3,881	399,610 80	79,078	33	1,820	4.97
1878	77,737 60	234 00	108 50	101 25	329 25	78,510 60	4,086	1,094,942. 0	245	6,489	4.05
Total	333,770 69	1,713 45	924 50	178 75	1,963 90	338,581 29	15,276	3,998,060. 05	332,080	6,489	.....

Expenses.

Year.	Lockage department.				Dredge department.				Total superintendent, eng., management, and repairs.	Permanent improvement.	Grand total.
	Labor.	Repair.	Miscellaneous.	Office expenses.	Labor.	Repair.	Miscellaneous.	Total.			
1874*	\$15,099 78	\$420 43	\$405 09	\$35 45	\$6,830 00	\$459 96	\$1,775 45	\$9,065 41	\$25,026 16	\$115 95	\$25,142 11
1875	28,265 57	700 63	513 13	39 08	12,873 19	884 22	3,309 56	17,066 87	46,585 38	3,174 11	49,759 49
1876	57,169 86	1,141 74	560 75	173 43	12,025 42	797 87	2,196 62	15,019 91	44,065 69	25,410 52	69,476 21
1877	28,608 77	2,020 65	1,988 02	139 48	10,869 31	378 86	2,245 61	13,493 78	45,350 60	15,591 82	60,942 42
1878	29,168 34	1,563 17	1,798 12	224 89	9,979 08	666 81	2,053 91	12,599 80	44,354 32	31,113 60	75,467 92
Total	128,312 32	5,846 62	3,365 11	612 23	52,477 00	3,187 72	11,581 15	67,245 87	205,382 15	75,406 00	280,788 15

* From June 11th to end of year.

APPENDIX V.

ANNUAL REPORT OF MAJOR WILLIAM E. MERRILL, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1879.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, August 12, 1879.

GENERAL: I have the honor to submit herewith the annual reports on the works under my charge, for the fiscal year ending June 30, 1879. Respectfully, your obedient servant,

WM. E. MERRILL,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

V I.

IMPROVEMENT OF THE OHIO RIVER.

The following is a statement of the work done on this river from July 1, 1878, to June 30, 1879. The localities are named in the order of natural succession, beginning at Pittsburgh.

DAVIS ISLAND DAM.

(5 miles below Pittsburgh.)

Authority to begin active operations on this important work was received on the 24th of July, and on the 30th Lieut. F. A. Mahan, Corps of Engineers, to whom the local charge had been assigned, arrived at Pittsburgh. Actual work began on the 19th of August, on which day a small party commenced clearing away the brush on the site of the dam.

As rapidly as possible a large working force was gathered together, tools and plank were purchased, quarries were opened, and the work was put into active operation.

At the end of the fiscal year the work was in the following condition: All the excavations for the land wall and its two gate recesses had been made and the following walls had been built:

- Upper recess. { Upper wall.
Lower wall.
Back wall of filling culvert.
Half of arch of filling culvert.
- Lower recess. { Upper wall.
Back wall of emptying culvert.
- Land-wall, about one-fifth completed.

The amount of masonry in these walls is 515 cubic yards of cut stone, and 2,693 cubic yards of rubble, being a total of 3,208 cubic yards.

It should be mentioned that none of the walls are coped, and that they have been built since the 25th of April, 1879.

In addition to the above the lock-keeper's house has been built, a large sewer has been constructed to carry to a point below the lock the drainage of a large ravine, and a considerable amount of filling has been put in place. The latter work was quite needful in order to secure yard-room.

All the accounts of the work are being kept with great minuteness in order that the exact cost of every detail may be fully known. This information will be of great value in similar constructions in the future.

DIKE AT WHITE'S RIPPLE.

(11 miles below Pittsburgh.)

The repairs of this dike were begun in 1876, and at the close of 1877 2,793 linear feet of the work had been finished, terminating at the cross-dam. Work was resumed early in August, 1878, by rebuilding the cross-dam just below the landing at Middletown. This cross-dam was connected by a gentle curve with the lower dike, which was raised and completed for a further distance of 1,799 feet down stream. The total length of the completed work including the cross-dam is 5,392 feet, or about 100 feet more than a mile.

The reconstruction of these works has all been done in accordance with the plan which is fully described in my annual report for 1877. (Report of the Chief of Engineers for 1877, Part I, page 795.)

The following statement shows the total amount of materials expended on this work, with their cost. It does not, however, include the cost of the dam from the tow-head to the foot of Neville Island, a statement of which was given in last year's report.

580,188 feet, B. M., oak lumber, at \$16 to \$21 per M	\$9,980 99
195,964 feet, B. M., pine lumber, at \$16 to \$18 per M	3,295 69
68,181 feet, B. M., hemlock lumber, at \$9.99 to \$13 per M	731 32
98,867 pounds bolts, at 2 cents to 2½ cents per pound	2,295 89
3,837 pounds spikes, at 2½ cents to 4 cents per pound	127 46
4,513 pounds wrought iron, at 3½ cents to 6½ cents per pound	176 29
716 pounds ring bolts, at 7 cents to 8 cents per pound	51 91
8,243 cubic yards slag, at 49 cents to 70 cents per cubic yard	4,813 16
6,797 cubic yards stone, at 50 cents to \$1 per cubic yard	4,655 15
Tools and miscellaneous supplies	93 67
Paid for towing boats	33 00
Labor	11,684 68
	<hr/>
	37,939 21

Length of crib-work	5,392 feet
Cost per linear foot	\$7 04

When the ice broke up in the winter just past, the stone filling in some of the compartments on the down-stream side of the cross-dam was washed out. The damage was trifling in amount, and the cross-dam has since been put in thorough repair.

At the request of the people of Middletown 120 feet of the lower end of the upper dike was removed, in order to facilitate the entrance and exit of their commerce. This change puts Middletown into free communication with the main Ohio, an advantage of which it has been deprived since 1839, when the old dikes were built.

The engineer in charge at White's Ripple and the Trap was Mr. I. V. Hoag, jr.

FRENCH ISLAND DIKE.

(760 miles below Pittsburgh.)

The work of repairing a break in this dike was begun November 13' and continued to November 20, when a rise in the river stopped further operations. The gap in the dike was about 80 feet long and 10 feet deep. It had been mainly closed when work was suspended. Work was resumed about the middle of June, 1879, the shore protection being first strengthened to prevent a threatened cut at the root of the dike.

One hundred and sixty-two piles, 315 cords of brush, and 1,154 cubic yards of stone have been expended on this work during the year.

EVANSVILLE DIKE.

(789 miles below Pittsburgh.)

A special survey of this bar and dike was made in July, 1878, by Mr. I. V. Hoag, jr., the object of this survey being to ascertain the effect of the dike on the bar, and to determine whether the calculations on which the construction of this dike was based were in process of verification. The survey showed that the dike was doing its anticipated work with great effectiveness, but as the citizens of Evansville were anxious to have the work expedited, it was decided to lengthen it 500 feet. This increase in length will also be an additional guarantee of the permanency of the work already done. The contract was let to Mr. C. M. Cole.

Work was begun October 9 and closed for the season on November 27. Piles were driven for 426 feet of the proposed extension, and the dike was partly finished for this distance. Work was resumed on May 10, 1879, and continued to the end of the fiscal year, being confined principally to repairs on the old part of the dike and to strengthening the shore protection; 288 piles, 4,047 cubic yards of brush, and 8,304 cubic yards of stone have been expended on the work under the present contract.

During 1878 Mr. C. B. Bateman was the engineer in charge both at Evansville and at French Island. During 1879 Mr. J. N. Caldwell, jr., assistant engineer, has been in charge.

REMOVING ROCKS FROM UPPER OHIO.

Considerable progress was made during the year ending June 30, 1878, in removing rocks which obstruct the navigation of the shoal places in the Upper Ohio during the lowest stages of the river, and this good work was continued during the fiscal year just ended, two steamboats, the *Argo* and the *Carl Schurz*, having been employed for that purpose.

The *Argo*, operating between Pittsburgh and Marietta, worked from August 19 to September 12, when the river became too high to permit of further operations. As the snagboat *Woodruff* was unable to reach Pittsburgh on account of the low-water, the *Argo* began by removing the wreck of a ferry-boat in Glass House Ripple; she also removed the wreck of a coalboat at Saw-Mill Run, part of a flatboat, and the wreck of a coalboat at the foot of Deadman's Island, and 5 dangerous snags at various points. Two large rocks and about 20 tons of smaller ones were taken out at Sewickley Bar; a lot of rocks were broken up along the shore at Montgomery's Island; four very large

rocks were removed at the foot of Phillis Island; 17 large rocks and a large number of smaller ones from the channel opposite Georgetown Island; 2 rocks and the bottom of a coal-barge at the Clusters; 20 large, 12 smaller rocks from the channel opposite Black's Island (the large rocks would weigh $1\frac{1}{2}$ tons each); 1 large rock and 3 small ones opposite Freeman Kilns; 1 rock was removed at Will's Creek, and another very large one was blasted and the surface removed to the depth of the low-water channel; two snags were removed at New Cumberland Ferry, 4 from Deep Run Bar, and 1 opposite Elliottsville, Ohio.

The *Carl Schurz*, operating below Marietta, worked from August 26 to September 12, removing 139 large rocks and 220 smaller ones from head of Muskingum Island, Reppert's Bar, Little Hockhocking and Mustapha Islands, Lee's Creek Bar, Belleville Island, De Witt's Bar, Goose Island, Letart's Falls, Clifton, Eight Mile Island, Straight Ripple, and Guyandotte Shoals.

REMOVING ROCKS FROM GRAND CHAIN.

The river and harbor act of June 18, 1878, provided that the sum of "\$50,000 shall be expended at Grand Chain for the removal of obstructions and deepening the channel at that point."

It was decided that it would be best to begin by removing some of the more dangerous of the rocks that infest this part of the Ohio, and accordingly the wrecking boat *Charlie Hill* was chartered, and the boat and crew were placed under the direction of Mr. P. Golay, assistant engineer. They were employed on this work from August 13 to November 30, completely removing the "Arkansas" rock, or group of rocks, situated about a mile below the head of the Grand Chain. These rocks were removed to the surface of the surrounding sand and gravel, and a depth was obtained over them $1\frac{1}{2}$ feet greater than there was on the bars above and below; 310 cubic yards of solid rock was removed at this point, at a cost of \$5,698.25, or \$18.38 per cubic yard. The rock was a hard limestone, but it was full of seams, and the method used was that of surface blasting by means of "Hercules" powder, one of the nitro-glycerine compounds. The cartridges were exploded by a magneto-electric battery. A diver was employed to place the cartridges or torpedoes in position for breaking the rock and to assist in removing the fragments after blasting. The work was continued until suspended by reason of high-water.

There are doubtless other isolated rocks and knobs in this vicinity, but they project so little above the usual level of the sand that it is very difficult and costly to find them. The Grand Chain is only about 20 miles above Cairo, and consequently the currents and the deposits are both greatly affected by the stage of the Mississippi. During some seasons the rocks in the channel are covered with sand, and they cannot be found unless dug for. They are most prominent when a long continuance of low-water in the Mississippi gives the Ohio a chance to cut out.

It is believed that the treatment for this dangerous locality is to build dikes which will fence off the main ledge and the more prominent rocks, and at the same time will so accelerate the current as to make visible the rocks that remain in the channel-way. By this means rocks that occasionally project above the sand, but are usually buried, will be developed and be easily removed. The most serious trouble at present is to find them and to blast them deep enough in their sandy beds.

SNAGBOAT E. A. WOODRUFF.

The *E. A. Woodruff* began work for 1878 on August 1, and closed operations on December 15, being laid up for the winter in the mouth of the Kentucky River.

During this year she worked over the river as follows:

Cincinnati, Ohio, to Saint Mary's, West Va.; Saint Mary's to Cairo, Ill.; Cairo to Sewickley, Pa.; Sewickley to winter quarters in the mouth of the Kentucky River.

The sum of the season's work was 499 snags and 26 wrecks of steamboats and barges.

The total weight of snags removed was 3,702 tons, and the average weight 7.4 tons. The heaviest snag raised during the year was taken from the river about 400 yards below Haskelville, Ohio, and weighed 84.10 tons. The distance run was $2,946\frac{1}{4}$ miles.

The following table shows the work of the snagboat in detail during the year 1878:

Week ending -	Snags removed.	Weight of snags.	Wrecks removed.	Miles run.	Remarks.
		Tons.			
Aug. 3	1	5.40	.....	289 $\frac{1}{2}$	Cincinnati to Briscoe Run.
10	38	149.41	.....	117 $\frac{1}{2}$	Briscoe Run to Pomeroy.
17	54	468.25	.....	63 $\frac{1}{2}$	Pomeroy to Catlettsburg.
24	19	136.29	.....	38 $\frac{1}{2}$	Catlettsburg to Portsmouth.
31	61	480.31	.....	83 $\frac{1}{2}$	Portsmouth to Catlettsburg and return.
Sept. 7	41	382.05	.....	61 $\frac{1}{2}$	Portsmouth to Maysville.
14	44	376.79	.....	74 $\frac{1}{2}$	Maysville to Cincinnati.
21	.....	.....	.....	.....	Laid up by high water.
28	.....	.....	1	28	Laid up till 25th. Wreck removed at Cincinnati.
Oct. 5	54	362.96	.....	149 $\frac{1}{2}$	Cincinnati to Carrollton, Ky., and return.
12	31	130.79	.....	163 $\frac{1}{2}$	Cincinnati to New Albany.
19	30	152.68	.....	91	New Albany to Flint Island.
26	.....	.....	.....	.....	Laid up at Flint Island by low-water.
Nov. 2	24	156.85	.....	102	Flint Island to Evansville.
9	52	461.45	.....	104 $\frac{1}{2}$	Evansville to Cave-in Rock.
16	23	271.80	.....	201	Cave-in Rock to Cairo, and return to Weston, Ky.
23	20	68.89	.....	395 $\frac{1}{2}$	Weston to Cincinnati.
30	.....	.....	.....	453	Cincinnati to Sewickley.
Dec. 7	3	28.05	.....	172	Sewickley to Parkersburg.
14	4	70.37	.....	283	Parkersburg to Cincinnati.
16	.....	.....	.....	74 $\frac{1}{2}$	Cincinnati to mouth of Kentucky River.
Total ...	499	3,702.34	26	2,946 $\frac{1}{4}$	

During 1878 the snagboat was commanded by Capt. H. H. Drown. The present captain is W. H. Christian.

DREDGING.

The dredges Ohio and Oswego, after undergoing their annual spring repairs, went to Green Bottom Ripple, where they arrived on August 5. High-water, however, prevented them from working until the 12th. From this date both boats worked with little interruption until November 14, when high-water, which continued to the end of the month, compelled a suspension for the season. The dredges went into winter quarters early in December in the mouth of the Muskingum River.

They again resumed work on May 31, 1879, and continued without interruption to the end of the fiscal year.

GREEN BOTTOM RIPPLE.

(290 miles below Pittsburgh.)

The work proposed at this place was to straighten the channel by dredging off the points of the two bars (one abreast of the government light on the Ohio side of the channel, and the other below it on the Virginia side), and to remove a lump still further down on the Ohio side. This work was completed on September 4, and resulted in materially straightening and widening the channel; 16,563 cubic yards of excavation was made at this place.

CONCONNOQUE BAR.

(365 miles below Pittsburgh.)

The object of dredging at this place was to straighten the channel by removing the points of the bar on the Ohio shore just below the crossing to the Virginia side. This work was completed at the end of October; 19,288 cubic yards of excavation having been made. Two large snags were also removed from this bar by the dredges.

BUENA VISTA, OHIO.

(371 miles below Pittsburgh.)

One snag was removed from the channel just above Buena Vista.

QUICK'S RUN BAR.

(379 miles below Pittsburgh.)

The improvement of this channel was accomplished by dredging off the point of the reef on the Ohio side and two points from the run bar on the Kentucky side, the available depth for navigation being increased some 18 inches. The dredge worked at this place from October 8 to October 28, removing 19,435 cubic yards of gravel from the bar.

BRUSH CREEK BAR.

(385 miles below Pittsburgh.)

Eleven thousand one hundred and ninety-nine cubic yards of excavation were made at this bar between November 7 and November 14, the only time during the month when the stage of water would permit of work. Six logs and the greater part of the wrecks of a coal-boat and of a stone-boat were also removed from this bar by the dredges.

DAVIS ISLAND DAM.

(5½ miles below Pittsburgh.)

The dredges having been put in order for the season of 1879 began work at Davis Island dam. They have been employed to excavate for the foundation of the river wall of the lock, for the coffer-dam around the wall, and for the movable dam across the head of the lock. A landing for flatboats has also been dredged out on the bank of Davis Island. Excavation made, 11,589 cubic yards.

STOUP'S FERRY.

(13 miles from Pittsburgh.)

At this place a landing was excavated to be used for loading stone from the Stoup's Ferry quarry for transportation to the Davis Island dam. The material excavated, consisting principally of loose rock and shale, was "thrown into bank," forming a road-bed, upon which a track has been laid for the cars which bring the stone from the quarry. Excavation made, 3,311 cubic yards.

THE TRAP.

(12 miles from Pittsburgh.)

The dredge Oswego worked at this point during the low-water of June, when no other work could be reached, the object being to remove a "lump" from the channel. Excavation made, 1,058 cubic yards. The following tables show the details of the work done by the dredges during the year 1878:

DREDGES IN COMMISSION.	
Time at work:	
Ordinary dredging	Days. 45½
Wrecking and snagging	2½
Work on Wabash River	94
Time lost:	
Traveling	5
Accidents	6
High-water	44
Sundays	17
Total	214
Total on Ohio River	120
Work done:	
Gravel, &c., excavated during season	Cubic yards. 66,485
Gravel, &c., excavated per working day	1,461
Number of wrecks removed	2
Number of snags removed	11
Cost:	
Equipment—	
For the season	\$439 85
Per working day	9 16
Per day in commission	3 66
Towing—	
For the season	4,319 85
Per working day	90 00
Per day in commission	35 99
Salaries—	
For the season	6,311 57
Per working day	113 49
Per day in commission	52 59
Repairs—	
For the season	256 02
Per working day	6 17
Per day in commission	2 47

Time:		DREDGES OUT OF COMMISSION.	
		Days.	
In ordinary		115	
Annual spring repairs		36	
Total		151	
Cost:			
Total	\$5,044	84	
Per day ordinary		8	24
Annual spring repairs	3,801	36	
Salaries in ordinary	1,243	48	
Expenditures:			
For dredging, gravel excavation	15,558	27	
For removal of wrecks and snags		854	85
Per day in commission		136	77
Per working day		341	94
Per cubic yard of excavation		0.	234

1878.	Miles from Pittsburgh.	Place.	Kind of work.	Days at work.	Excavation.		Expenditure.		Grand total.
					Cubic yards gravel.	Cubic yards per day at work.	Total for dredging.	Total for wrecks and snags.	
August and September	290	Green Bottom Ripple	Dredging	10	16,563.0	1,656.3	\$3,419 40	.....	\$3,419 40
September and October	365	Concoqueque Creek	do	14	19,288.0	1,377.7	4,787 16	.....	4,787 16
October	365	do	Snags	1			\$341 94	.....	341 94
October	371	Brown Vista, Ohio	do	14 $\frac{1}{2}$	19,435.0	1,340.4	4,958 13	.....	4,958 13
October	379	Quick's Run	Dredging	7	11,199.0	1,599.8	2,393 58	.....	2,393 58
October and November	385	Bush Creek Island	do	1				.....
November	385	do	Wrecks and snags	1				.....
				48	66,485.0	1,461.2	15,558 27	854 85	16,413 12

It will be seen from the foregoing table that the relative cost of work was greater in 1878 than in 1877. This was due to the fact that work did not begin until August, thus leaving a very short working season, and to the additional fact that the river was exceptionally high during the autumn of 1878, and the dredges lost much time in consequence. The dredges, as heretofore, were directed by Mr. E. J. Carpenter, assistant engineer.

SEDIMENT OBSERVATIONS.

In compliance with instructions from the Chief of Engineers, dated August 30, 1878, a series of daily observations for determining the amount of sediment in the water of the Ohio River was begun at Paducah, Ky., on December 16, and has been continued to the end of the fiscal year, with the expectation that it will be continued until the close of 1879. Mr. C. B. Bateman, assistant engineer, has been in charge, and at the same time he has had charge of the construction of an iron water-gauge at Paducah. The navigators of the Lower Ohio petitioned for this gauge as a guide for running the Grand Chain.

The gauge is completed except its lowest section, which can only be constructed during extreme low-water.

OFFICE WORK.

The chief work in the office has been the preparation of detailed drawings for the construction of the Davis Island Dam, and for an iron hull to replace the worn-out wooden hull of the United States dredge Ohio.

Besides this the river hydrographs have been platted up to date, and various miscellaneous maps, tracings, and drawings have been made.

ESTIMATE FOR 1879-'80.

It is always a difficult and embarrassing matter to submit an estimate on a great river like the Ohio. All rivers contain a series of bars or shoal places over which less water can be carried than elsewhere, and the object of all works of river improvement is to add to the paying tonnage of river craft by increasing the depths on these bars. On the Ohio there are two hundred well-defined bars, and many others with which navigators do not now concern themselves, but which will become prominent in case the better known bars are deepened. It is evident that simultaneous work could be undertaken on all of these bars, and as the necessary constructions are independent of each other, the engineer in charge can utilize any amount of money that does not exceed the total sum necessary to improve them all at one time.

It may therefore be safely and properly stated that whatever sum Congress is likely to appropriate can be used to advantage. Considering the magnitude of the river and the large amount of commerce borne on its waters, the appropriation for its improvement ought to be at least \$500,000, independent of the sum required for the special work at Davis Island.

The bars that at this present seem most in need of improvement are Sand Creek, Twelve Pole, Flint Island, Oil Creek, Puppy Creek, Scuffletown, Three Mile Island, Shawneetown, Caseyville, Walker's, and Cottonwood; but all of these are variable in depth, sometimes remaining good for several years. Although these are named as the worst bars at the date of this report, others may prove to be greater obstructions before the present season is ended. When operations are resumed in

1880 it may be advisable to omit some of the above named and to take up others. It is owing to these fluctuations, and to the impossibility of making a close estimate on any single dike, that it seems best to submit a lump estimate for the whole river. Moreover, the experience of each season indicates improved methods of resisting the forces of the river (of which ice is by far the most formidable), and better methods of construction might be suggested by the time that it becomes necessary to resume work.

For the movable dam at Davis Island an appropriation of at least \$200,000 ought to be made. This will enable us to finish the masonry of the lock and of the navigable pass, and probably to do other work. After the navigable pass is built the most difficult and the most hazardous part of the work will be finished, and it will be practicable to make reliable estimates of the cost of completion; until we have crossed the river channel and have gotten out of danger from river floods, it is hardly worth while to attempt a detailed estimate; the contingencies are too great.

I would, therefore, submit the following:

For dredging, snagging, building dikes, &c.....	\$500,000
For Davis Island Dam.....	200,000
Total for improvement of Ohio River	700,000

Money statement.

July 1, 1878, amount available.....	\$389,715 33	
Outstanding liabilities	391 72	
Amount appropriated by act approved March 3, 1879.....	250,000 00	\$640,107 05
July 1, 1879, amount expended during fiscal year.....	272,176 20	
July 1, 1879, outstanding liabilities	28,821 35	300,997 55
July 1, 1879, amount available.....		339,109 50
Amount that can be profitably expended in fiscal year ending June 30, 1881.		700,000 00

STAGES OF WATER IN OHIO RIVER, OBSERVED AT THE SMITHFIELD STREET BRIDGE, PITTSBURGH, PA., FROM JANUARY 1, 1855, TO DECEMBER 31, 1878.

REPORT OF LIEUTENANT F. A. MAHAN, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Pittsburgh, Pa., August 25, 1879.

SIR: During the past year I have given such spare time as I could to the study of the records of the stages of water observed daily at the Smithfield Street Bridge, Pittsburgh, Pa., from January 1, 1855, to December 31, 1878.

A summary of the results of this study is given in the following tables.